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A comparison of the gonadal maturation of a sea urchin, Strongylocentrotus intermedius, from Soya and Rebun Island in northern Hokkaido

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A Comparison of the Gonadal Maturations in the Sea Urchins, *Strongylocentratus intermedius*, from Soya and Rebunjima in Northern Hokkaido

(Soya, Rebunjima Ryochi ni okeru Ezobafun Uni no Seishokuso Seijuku no Hikaku)

by Ken'ichiro TAJIMA, Kyoji TOMITA (Wakkanai Fisheries Experimental Station), Keigo KUDO (Center for Marine Technique Diffusion and Training of the Rebun region), Minoru MATSUYA * and Takao YOSHIDA** (Center for Marine Technique Diffusion and Training of the Wakkanai region)

in Hokusuishigeppo (Monthly Report of the Fisheries Experimental Station of Hokkaido, Vol. 35, No. 2, special edition (February 1978)

In order to plan for the multiplication of marine animals, it is important to know the gonadal maturation stages of the target species. It is more particularly meaningful to grasp these quantitative and qualitative changes in the case of sea urchins, as their gonads constitute the precise targets of production. The *Strongylocentratus intermedius* (abbreviated hereafter as "Si" : translator) spawning periods in the various areas of Hokkaido have so far been elucidated through surveys of the seasonal changes in the gonadal weight as well as through histological observations of the formation stages of the reproductive cells [1-9]. However, there is a shortage of reports about Si in the Hokkaido region [5]

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In order to know the maturation stages of the Si gonads in the Hokkaido region, we conducted a study in Soya and at Horodomari, Rebun island, city of Wakkanai (Fig. 1). To know the spawning periods more accurately, we made a survey of the appearance times of the early floating larvae. Ou results are reported hereunder.

Before entering the subject, we wish to thank the Soya Fisheries Cooperative, the Funadomari Fishing Cooperative as well as their personnel which helped us gathering the sample materials.

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Materials and method

In the present study, we used adult Si (shell diameter of at least 4 cm). At collection time, we established in both locations fixed points with depths of about 2 m. At Soya, we collected the material 11 times from October 1974 to November 1975. Each time, we collected 25 individuals. At Rebunjima, we collected the material 19 times from June 1973 to October 1975. We measured the shell diameters, the total weights and the gonad weights of the gathered samples, after which we fixed sections of the gonads of 10 specimens in Bouin's fluid for the histological observation of the gonads. The sections were prepared by the ordinary paraffin method to thicknesses of 5-9 µ. We performed double staining, that is, light green with Heidenhain's iron hematoxylin, and eosin with Delafield's hematoxylin.

We calculated the gonadal indices from the proportion of gonadal weight vs. the total weight.

$$\left(\text{gonadal index} = \frac{\text{gonadal weight}}{\text{total weight}} \times 100\right)$$

The early floating larvae were collected by pulling horizontally or vertically a Kitahara-style surface plankton net (XX 13).

The water temperatures are quoted from the [fish farm sea conditions flash reports] edited by the Hokkaido Association for the Development of Resource & Technology. As for Rebunjima, we used the daily measurement data for 5 m depths in the Funadomari Bay, established by the Abalone Culture Center of the Funadomari Fisheries Cooperative.

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Results

1. Seasonal changes in gonadal maturation

We divided the maturation stages of the gonads of adult Si originated from both Soya and Rebunjima into recovery, growth, early maturation, late maturation and release periods according to the divisions established by Fuji [1].

December-February : In the December ovaries from Soya, primary oocytes with a major axis of about 18 μ are dispersed along the reproductive vesicle walls. All were at the recovering period (photograph 1 - 1). Thereafter, the primary oocytes grew further and increased in number, and there appeared some specimens reaching the growth period in February (photograph 1 - 2). Many specimens were still at the recovery period. All February ovaries from Rebunjima were at the recovery period.

The December testes from Soya had still residual spermatozoa in their reproductive vesicle cavities. They were at the release period when the formation of the spermatozoa is not active (photograph 2 - 1), or at the recovery period when the formation of spermatozoa becomes active, and when the spermatogonia and spermatocytes are lined up along the reproductive vesicle walls (photograph 2 - 2). In February, the formation of spermatozoa progressed, spermatozoa were observed in the cavity of the reproductive vesicle, and there appeared individuals who had reached the early maturation period (photograph 2 - 4). Many of the February testes from Rebunjima were at the recovery period, but some were believed to be still at the release period. Maturity came later than in Soya.

March-April : Many of the ovaria from Soya were at the growth period. We observed that admixed to the primary oocytes (photograph 1 - 4), there were secondary oocytes undergoing meiosis as well as a few mature eggs having terminated their divisions (photograph 1 - 5). There were also specimens which

were at the early maturation period (photograph 1 - 3). The mature eggs had extremely small female pronuclei of about 11 μ, and we observed in the cytoplasm black granules strongly stained by the Heidenhain's iron

hematoxylin. No survey was conducted at Rebunjima in 1975, but all specimens were at the recovery period in March 1974.

Many of the testes from Soya were at the growth period when numerous spermatocytes are packed on the walls of the reproductive vesicle (photograph

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2 - 3) or at the early maturation period. All male urchins from Rebunjima were similarly to the females at the recovery period in March 1974.

May - June : Many of the ovaria from Soya were progressing toward maturity. The major axis of the primary oocytes had grown to 60-100 μ, and numerous specimens were at the growth and early maturity period. Some specimens were at the later maturation period when mature eggs fill the cavity of the reproductive vesicle (photograph 1 - 6) or at the release period as spawning was considered as already performed (photograph 1 - 7). The specimens from Rebunjima were still at the growth period. We found no mature eggs in the cavity of the reproductive vesicle.

In the testes from Soya the spermatozoan formation was proceeding actively, the volume of spermatozoa in the reproductive vesicle cavity was increasing. The early maturation period was reached in May, and in June all specimens were at the later maturation period (photograph 2 - 5). As for the males gathered during this period, we noted an abundant outflow of spermatozoa at the dissection stage. Among the specimens of Rebunjima, the spermatozoa had begun to accumulate in the cavity of the reproductive vesicle, but they were still at the early maturation period.

July- August : The ovaria from Soya were in July at the early maturation period. In August, some indivisulas had reached the later maturation period or the release period. Yet, at this time, some specimens were still at the growth period. We noted differences in the maturity stages, depending on the individuals. The specimens from Rebunjima were passing from the growth period to the early maturation period, and mature eggs started to appear in the cavity of the reproduction vesicle.

Many of the testes from Soya were at the later maturation period in July - August. Some specimens were already at the release period when sperm was being released, and when a small volume of spermatozoa remains in the cavity of the reproductive vesicle (photograph 2 - 6). In Rebunjima, the specimens

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were at the early or later maturation period in July. In August, all specimens were at the later maturation period.

September-November : Some of the September ovaria of Soya were at the later maturation or at the release period, but numerous specimens were still at the early maturation period. No survey was conducted in October, but in November, all specimens were at the release period. In September, the specimens from Rebunjima were at the early maturation or late maturation period, and in October, all were at the release period.

Similarly to the ovaries, the state of the September testes from Soya ranged from the early maturation to the release period. In November, all specimens were at the release period. In Rebunjima, like in August, all specimens were at the later maturation period, and in October, all were at the release period.

2. Seasonal variations in the gonadal weights

We show in Fig. 3 the seasonal variations in the weight of the gonads, in terms of gonadal index.

In October 1974, the average value was 8.3 in Soya. In February 1975, it was 13.9, and so, we note a gentle increase during that period. In March, the gonads showed a remarkable increase to 19.1, and in April to 21.9. Until June, a high index value was exhibited.* In February, the appearance rate of individuals with an index value of 20 or more was 10 %. In March, it was 50 %, and in April 80 % or more. From July, the index value decreased slowly. In

November, the index value was 4.2. The appearance rate of individuals with an index value of 10 % or less was 20 % in July, 50 % in August, 70 % in September and 95 % in November.

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* The index value for May is not shown in Fig. 3. The reason is that the index value has an extremely low average of 11.7, as because of stormy weather, collection at the determined points was impossible and the collections were carried out at other sites. According to the report by Fuji [1], it is evident that if the sites of collection differ even though the period of time is the same, the gonadal indices will differ even if the development stages of the reproductive cells are the same.

From spring to summer, the rise in index value was generally gentler among the specimens from Rebunjima than among those from Soya.

In 1975, the highest average value was reached in August, 4 months later than in Soya. The rate of appearance of individuals with an index value of 20 or more was 50 % in August, and 20 % in September. In October, all specimens showed sharply decreasing index values of 10 or less. In 1974, the gonadal development was conspicuously poor. The average value was 12.2 in July, 9.8 in August, and 13.6 in September. In September, not more than 10 % of the specimens exceeded the index value of 20.

3. The state of appearance of the early floating larvae and the water temperature variations

Fig. 4 shows the state of appearance of the early floating larvae and the variations in water temperature.

In the course of the 6-time survey conducted from April to November in Soya, we collected early floating larvae at the 4-brachial stage within the period going from May to September, excluding June. During the 5-time survey conducted from June to October 1975 in Rebunjima, we collected (such) specimens from August to October.

During the September-February period, the water temperature in Soya was 2-6° C colder than in Rebunjima. More particularly, during the winter period, it dropped as low as - 2° C. However, during the period from April to August, we noted no great differences between the two sites.

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Discussion

There is generally a great deal of discussion about the relationship between the spawning by sea urchins and the water temperature. There is much diversity among the species [2) 11) 12) 13) 14)]. It is believed that with regard to Si, there does not seem to be a direct relationship [2) 14)]. The spawning periods of Si along the coast of Hokkaido differ according to the geography. On the coasts of southern Hokkaido and along the coasts of the Sea of Japan, the season goes from September to November [1) 2) 3) 5) 6) 9)]. Along the coasts of the Sea of Okhotsk, it comes somewhat sooner [4) 7)]. There is one spawning per year, but Kinoshita [8)] reported two spawning periods (spring and fall) in

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Usu. Hayashi observed in June Si floating larvae in the Funka Bay, which corroborates the spring spawning in this pelagic region.

In the present study, we compared the maturation stages of the Si gonads in Soya and Rebunjima. In May 1975, there already appeared in Soya females which were at the later maturation stage or at the releasing stage. In Rebujima, there is no such appearance prior to October. This more or less agrees with the state of appearance of the early Si floating larvae. In Soya, the larvae began to appear from May, but in Rebunjima, they began to appear from August only. The same is true for the variations in gonadal weights. In Soya, the gonadal index reached already of value of 19.1 in March, enough to produce targets for fishing. High index values were exhibited in Soya from April to June. Such values appear rather later in Rebunjima, that is, in August-September. In Soya, the decline in index value too lasts from July to October, and is relatively slow. In Rebunjima however, the decline is sharp, and goes from September to October. If one estimates the Si spawning seasons in the two areas on the basis of the qualitative and quantitative variations of the gonads and of the state of appearance of the early floating larvae, we see that the spawning season starts in Soya from around May, and lasts mainly from July through September. The period is long, as it extends from the time of rising to the time of dropping water temperature, and the spawning shows trends similar to those observed at the Abashiri- Saroma lake [4], and Rausu [9]. In Rebunjima, the trends are similar to those observed along the coasts of southern Hokkaido [2] [3], of the Sea of Japan [5] [6] [9] during the period of declining water temperature from September to October. We thus noted differences in the spawning seasons of Si between the two areas, even though the distance of 70 km between Soya and Rebunjima is not that great. Yet, the water temperatures are different indeed with the difference being greatest in the winter. The lowest water temperature in Soya is - 2° C on account of drift ice and freezing. In Rebunjima however, it is 2° C. On the other hand, the water temperature starts to rise in Soya from March on. In Rebunjima, the start comes in May. From August on, the water temperature in Soya is 2° C lower than in Rebunjima. The differences in water temperature between the two sites seem to have some effect upon the maturation stages of the Si gonads. This was demonstrated by the present survey. It is still necessary to conduct a more detailed investigation about the factors involved in the growth of the reproduction cells, including water temperature, food and the like.

Summary

We made a comparative study of the maturation stages of the Si gonads in Soya and Rebunjima-Horodomari, Wakkanai City, and obtained the following results.

1. The season of the increase and maturation of Is gonads comes sooner in Soya than in Rebunjima.

2. In 1975, the early Si floating larvae appeared in May in Soya whereas they appeared in August at Rebunjima.

3. The active spawning season is July - September in Soya and thus earlier than in Rebunjima where the same season goes from September to October. The season is also longer.

4. In Soya, spawning takes place mainly during the rising water temperature season. In Rebunjima, it takes place during the declining temperature period.

Graphs, tables and photographs

Fig. 1 The survey sites

a. Horodomari, b. Rebunjima, c. Rishiri island, d. Sea of Japan, e. Soya, f. Wakkanai City, g. Sea of Okhotsk

Fig. 2 Maturation stages of the Si gonads and the numbers of appearance

A. females, B. males, a. release period, b. later maturation period, c. early maturation period, d. growth period, e. recovery period, f. ..th month

O. from Soya ●. from Rebunjima

Fig. 3 Seasonal variations of the Is gonadal index

a. gonadal index, b. ..th month, c. from Soya, d. from Rebunjima, e. standard deviation

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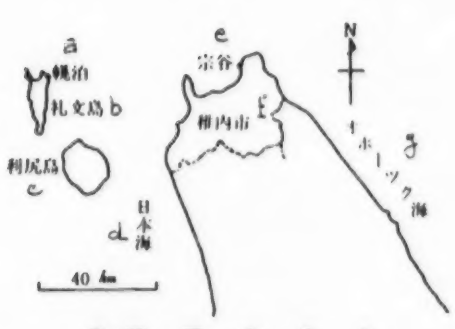
Fig. 4 Appearance of early Si floating larvae and the temperature variations
a. water temperature, b. Soya, c. Rebunjima, d. ..th month, e. period of appearance of early floating larvae, f. Soya water temperature, g. Rebunjima water temperature

Photograph 1 Maturation stages of the Is ovaria in Soya
1. recovery period, 2. growth period, 3. early maturation period, 4. primary oocytes, 5. mature eggs, 6. late mature eggs, 7. release period

Photograph 2 Maturation stages of the Is testes in Soya
1. - 6. (same as in photograph 1)



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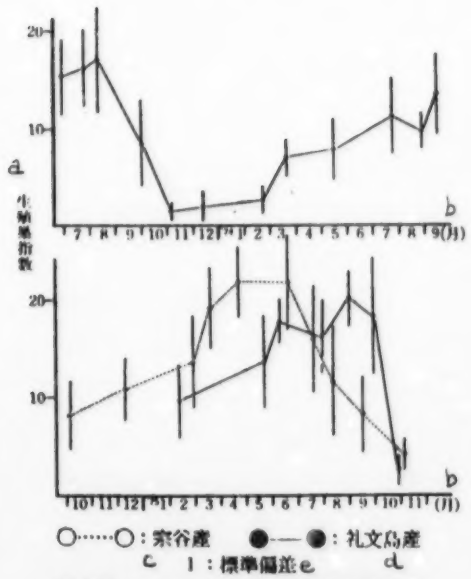
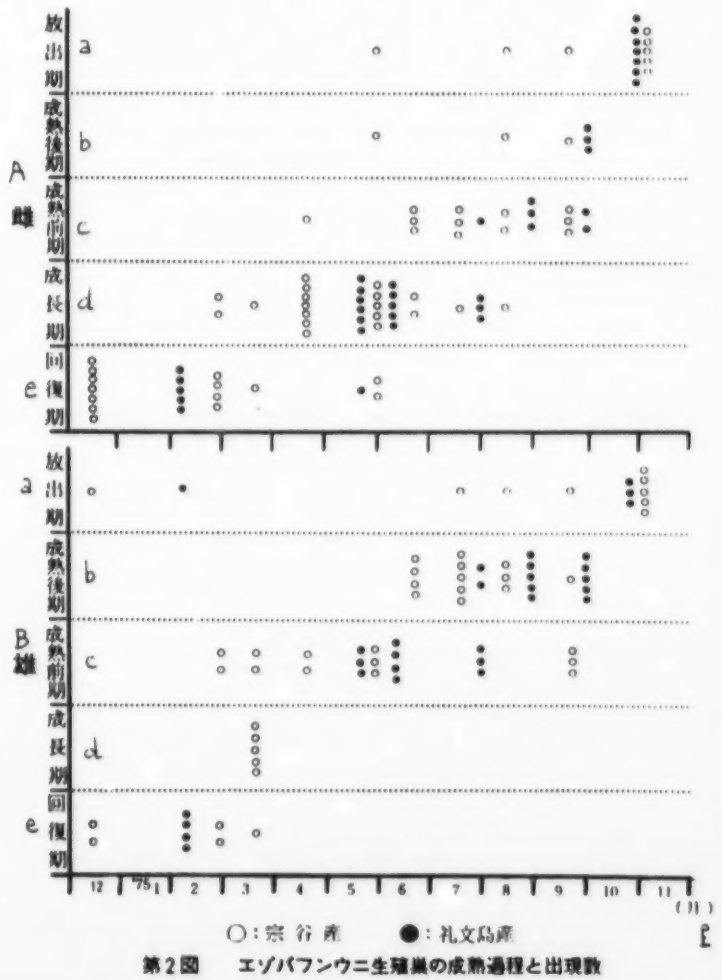
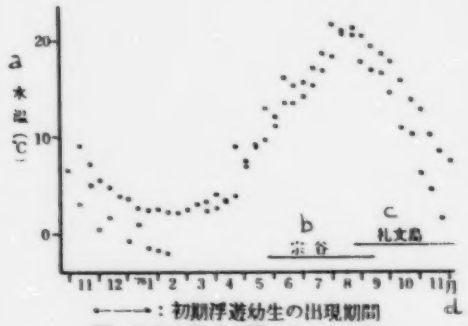


第3図 エゾバフンウニの生殖巣指数の季節的変化



第2図 エゾバフンウニ生殖巣の成熟過程と出現数



第4図　エゾバフンウニ初期浮遊幼生の出現期間と水温変化

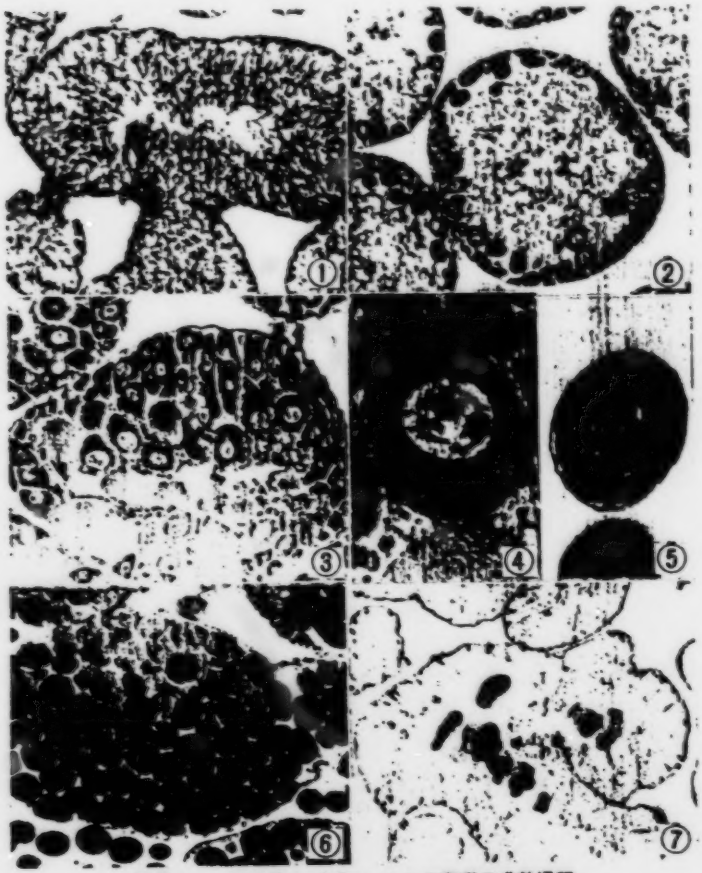


写真1　宗谷産エゾバフンウニの卵巣の成熟過程

1. 回復期　×65
2. 成長期　×65
3. 成熟前期　×65
4. 第1次卵母細胞　×300
5. 成熟卵　×300
6. 成熟後期　×65
7. 放出期　×65

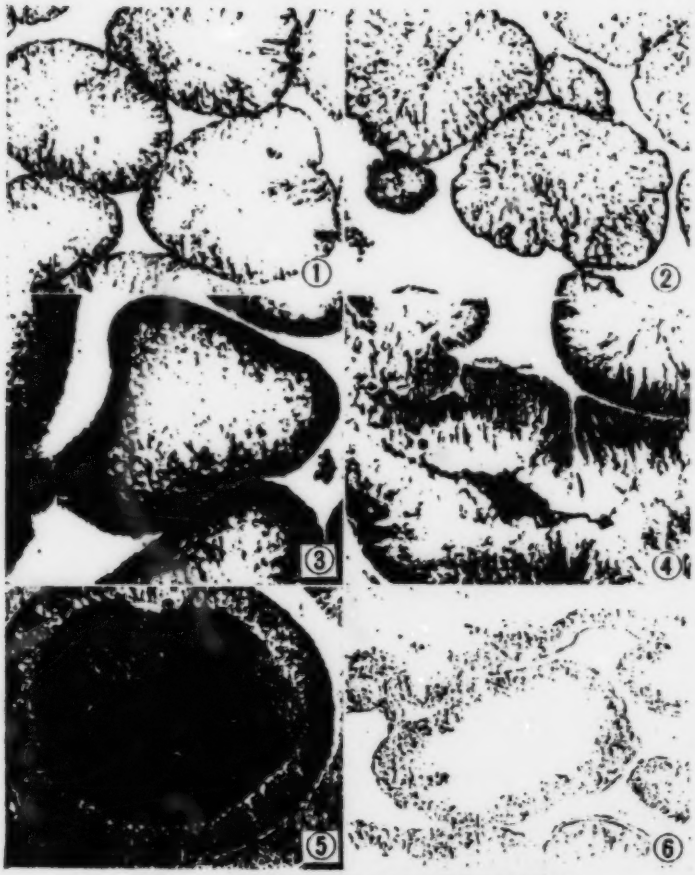


写真2　宗谷産エゾバフンウニの精巣の成熟過程

1. 放出期　×65
2. 回復期　×65
3. 成長期　×65
4. 成熟前期　×65
5. 成熟後期　×65
6. 放出期　×65

Bibliography

文　　献

1) Fuji, A. (1960) : *Bull. Fac. Fish. Hokkaido Univ.* 11 1 - 14
2) 〃 〃 (1960) : 同誌 11 195 - 202
3) 富士昭ほか (1969) : 磯根資源調査研究報告書 1 - 34
4) 川村一広 (1960) : 本誌 17 (8) 8 - 18
5) 〃 〃 (1965) : 北水試報 (3) 19 - 38
6) 〃 〃 (1967) : 本誌 24 (3) 36 - 45
7) 〃 〃 ほか (1969) : 羅臼町沿岸のウニ資源調査報告書 1 - 50
8) 木下虎一郎 (1955) : 本誌 12 (7) 24 - 26
9) ウニ研究グループ (1962) : 本誌 19 (8) 18 - 26
10) 林　忠彦 (1967) : 北水試報 (7) 72 - 83
11) Moore, H. B. (1934) : *J. mar. biol. Ass. U. K.* 19 869 - 885
12) 〃 〃 ほか (1963) : *Bull. Mar. Sci. Gulf and Carib* 13 (1) 23 - 53
13) Boolootian, R. A. (163) : *Nature* 197 (4865) 403
14) 川村一広ほか (1965) : 本誌 22 (3) 22 - 39

2. same journal
3. Akira FUJI et al. (1969) : Isone Shigen Chosa Kenkyu Hokokusho (Report of the Isone resources survey) 1 - 34
4. Kazuhiro KAWAMURA (1960) : this journal 17 (8) 8 - 18
5. Hokusuishiho (abbreviated title; Report of the Experimental Fisheries Station of Hokkaido)
6. this journal
7. Same author as in 4. above + al (1969) : Rausu-cho Engan no Uni Shigen Chosa Hokokusho (Report of the urchin stocks survey along the coast in Rausu), 1 - 50
8. Toraichiro KINOSHITA (1955) : this journal 12 (7) 24 - 26
9. Uni Kenkyu Gurupu (Urchin Study Group) (1962) : this journal, 19 (8) 18 - 26
10. Nobuhiko HAYASHI (1967) : same publication as in 5. above, (7) 72 - 83
11. Same author as in 4. above + al (1965) : this journal 22 (3) 22 - 39

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